

REMARKS

Applicants have carefully considered the points raised in the Office Action and believe that the Examiner's concerns have been addressed as described herein, thereby placing this case in condition for allowance.

Status of the claims

Claims 1-3, 6-11, 14-27, 30-40 and 49-58 are pending. By virtue of this response, claims 10, 33, 34, 40, and 50 have been amended to correct clerical errors. No new matter has been added by virtue of the amendments to the claims.

With respect to any claim amendments or cancellations, Applicants have not dedicated to the public or abandoned any unclaimed subject matter and moreover have not acquiesced to any rejections and/or objections made by the Patent Office. Applicants expressly reserve the right to pursue prosecution of any presently excluded embodiments in one or more future continuation and/or divisional application(s).

Claim Objections

Claims 10, 33, 34, 40, and 50 are objected to for various informalities. By virtue of this response, the claims have been amended to incorporate the Examiner's suggested language. Thus, the objections to the claims are moot.

Withdrawal of the objections to the claims is respectfully requested.

Claim Rejections under 35 U.S.C. §103

Claims 1-3, 6, 7, 9-11, 14, 15, 17-23, 25-27, 30, 31, 33-35, 38, 39, 49-51 and 54-57 are rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Kmecak et al. (EP 0 171 460) in view of Williams (U.S. Patent No. 4,422,925). Applicants respectfully traverse this rejection.

The present claims are directed to a riser reactor having a pre-lift zone, a first reaction zone, a second reaction zone, and an optional outlet zone. The claimed reactor is divided into two

reaction zones, with a ratio of the diameter of the second reaction zone to the diameter of the first reaction zone in the range of 1.5 to 5.0. The device is configured to prolong the time that oil vapor contacts the catalyst, increasing the contact time from about 3 seconds, as taught by Kmecak et al., to more than 5 seconds. Applicants have discovered that a longer oil-catalyst contact time improves the distribution of products and also enhances the quality of the products. In contrast, Kmecak et al. teach that a *short* oil-catalyst contact time can improve product distribution. Kmecak et al. state that “[t]he *short residence times* identified are not detrimental to the process and *may be used with considerable advantage to maintain desired product selectivity* by reducing any tendency of over-cracking to occur.” Page 49, lines 20-24, emphasis added. Thus, this reference teaches away from a device with a longer oil-catalyst contact time than taught by Kmecak et al., *i.e.*, 3 seconds.

A difference between the presently-claimed reactor and the reactor disclosed by Kmecak et al. is that the ratio of the second reaction zone diameter to the first reaction zone diameter is 1.5 to 5.0 in the present claims, whereas the ratio of the so-called second reaction zone diameter to the so-called first reaction zone diameter disclosed by Kmecak et al. is less than 1.5. In the reactor of Kmecak et al., the oil vapor – catalyst contact time does not exceed 3.0 seconds (see page 51, line 24 – page 52, line 5, claim 9; page 40, lines 19-21; page 41, lines 7-12; page 49, lines 7-24). If the ratio of the so-called second reaction zone diameter to the so-called first reaction zone diameter were greater than 1.5 in the reactor of Kmecak et al. the oil vapor would contact the catalyst for more than 3.0 seconds, as discussed in greater detail below.

In the example provided by the Examiner on pages 11-13 of the Office Action, using values extracted from the data on page 49, lines 8-24, and proportions extracted from the embodiment in the drawing of Figure 8 of Kmecak et al., the Examiner states that the following parameters apply to the riser reactor of Kmecak et al.:

- riser reactor height = about 49 meters
- average linear velocity of the suspension in the riser reactor = about 24 m/s
- total time required to traverse the riser reactor = about 2 seconds

- total time within the prelift zone of the riser reactor (*i.e.*, the dry gas-steam-catalyst suspension residence time before contact with the atomized oil feed) – a fraction of a second up to 0.5 seconds
- total time with the first reaction zone, second reaction zone, and first conjunct section, combined (*i.e.*, hydrocarbon residence contact time with catalyst particles) = up to about 1 or 1.5 second

The Examiner further states that if the total residence time within the riser reactor of Kmecak et al. is set at 2 seconds, one can assume a residence time of roughly 0.5 seconds within the prelift zone and a residence time of roughly 1.5 seconds within the first reaction zone, second reaction zone, and first conjunct section, combined, as suggested by the data above.

From the proportions shown in Figure 8, the Examiner states that the riser reactor appears to be configured roughly as follows:

- prelift zone height ($0.1 \times H$) = 4.9 m
- first reaction zone height ($0.3 \times H$) = 14.7 m
- second reaction zone height ($0.5 \times H$) = 24.5 m
- first conjunct section height ($0.1 \times H$) = 4.9 m

where H is the total height of the riser reactor, or $H = 40$ m

The Examiner further states that the average linear velocity of the suspension in the prelift zone equals the height of the prelift zone divided by the residence time within the prelift zone, or approximately 9.8 m/s, and the average linear velocity of the suspension in the first reaction zone, second reaction zone and first conjunct section, combined, equals the sum of the heights of the first reaction zone, second reaction zone and first conjunct section, or approximately 29.4 m/s.

Applicants respectfully submit that when the residual oil feed is fed through inlet 5 in Figure 8 (residual oil feed by one of 5 feed inlets, as described on page 40, lines 1-5; if it is fed through inlet 7 or 9, the lower part is merely equivalent to the prelift zone), supposing a velocity at the outlet of the so-called first reaction zone of U m/s, with a ratio of second reaction zone to first

reaction zone diameters of 3:1, as alleged by the Examiner on page 4 of the Office Action, the velocity of the second reaction zone will be $U/9$. The average linear velocity between the first reaction zone and the second reaction zone is equivalent to the linear velocity at the outlet of the first reaction zone. Using the formula $14.7/(9.8 + U)/2 + 24.5/U/9 + 4.9/U = 1.5$, the linear velocity at the outlet of the first reaction zone is calculated to be 160 m/s, which is clearly an unreasonable value. Even if the ratio of the second reaction zone diameter to the first reaction zone diameter is 1.5:1, rendering a velocity in the second reaction zone of $U/2.25$ m/s, the linear velocity at the outlet of the first reaction zone is calculated to be 55 m/s, using the formula $14.7/(9.8 + U)/2 + 24.5/U/2.25 + 4.9/U = 1.5$. However, Kmecak et al. disclose a riser with a linear velocity between 18 and 31 m/s (see page 49, lines 7-15). Thus, the ratio of the diameter of the so-called second reaction zone to the so-called first reaction zone diameter is less than 1.5:1. These values clearly contradict the Examiner's arguments.

From another viewpoint, according to the disclosed linear velocity of 18 to 31 m/s within the riser of Kmecak et al. (see page 49, lines 7-15), it can be deduced that the ratio of the so-called second reaction zone diameter to the so-called first reaction zone diameter is less than 1.5:1 as follows:

Assuming that the inlet linear velocity of the feedstock in the so-called first reaction zone is about 8.2 m/s, and the average linear velocity of the suspension in the prelift zone is 9.8 m/s, the inlet vapor linear velocity of the so-called first reaction zone is 18 m/s $[(9.8 + 8.2)]$, meeting the requirement for the linear velocity disclosed by Kmecak et al. If the outlet linear velocity of the so-called first reaction zone is 31 m/s, the maximum linear velocity of the so-called first reaction zone is 24.5 m/s $[(18 + 31)/2 = 24.5]$. Thus, the minimum time for contacting vapor with catalyst is 0.6 seconds $[14.7/24.5 = 0.6]$. The residence time of the first conjunct section is 0.158 seconds $[4.9/31 = 0.158]$.

Using values known in the art of about 400 g/mol for the molecular weight of feedstock and about 100 g/mol for molecular weight of product, it can be calculated that the volume of oil vapor will be increased by about 4 times. When the diameter of the riser is unchanged, the maximum linear velocity of the riser is about 42.6 m/s $[9.8 + (4 \times 8.2) = 42.6]$. If the ratio of the so-

called second reaction zone diameter to the so-called first reaction zone diameter is 1.5:1, the maximum average linear velocity of the so-called second reaction zone is 18.93 m/s $[42.6/2.25 = 18.93]$, and the maximum time for contacting vapor with catalyst is 1.294 seconds $[24.5/18.93 = 1.294]$.

The total minimum residence time between the so-called first reaction zone, the so-called second reaction zone, and the first conjunct section is $0.6 + 0.158 + 1.294 = 2.05$ seconds, which is greater than 1.5 seconds. Therefore, it is impossible for the ratio of the so-called second reaction zone diameter to the so-called first reaction zone diameter in the riser taught by Kmecak et al. to be greater than 1.5:1.

As Applicants previously explained in the response filed on November 14, 2005, when the linear velocity of a riser is greater than 30 m/s, judging from the flow pattern of fluidization, the gas in the entire riser is transported in dilute phase, and the oil vapor cannot fully contact the catalyst. A person having ordinary skill in the art would understand that when the average linear velocity of a riser is about 30 m/s or greater, the riser is a duct rather than a reactor. As shown in Figure 7.19 of Fluidization, J.F. Davidson et al., ed., Academic Press, Orlando, Florida, 1995, page 257, a copy of which was submitted with the response filed on November 14, 2005, when the linear velocity of the gas is greater than 10 m/s, the voidage of the riser is nearly 1, which means that the catalyst content in the riser is relatively low. This point is also illustrated in Fig. 10-10 of Fluidization Idealized and Bubbleless with Applications, M. Kwauk, ed. Science Press, Beijing, 1992, page 173, a copy of which was submitted with the response filed on November 14, 2005. A person of skill in the art would realize that if the linear velocity at the outlet of a riser is about 20 m/s, and is not greater than 30 m/s, the average linear velocity of the entire riser is from about 10 to 15 m/s, which is between that of a high-velocity fluidized bed and that of a gas dilute phase transport system.

As discussed above, Kmecak et al. do not teach a riser reactor with the claimed ratios of reaction zone diameters. For reasons of record in previously-filed responses, Williams et al. do not cure this defect of Kmecak et al. Williams et al. do not teach a riser reactor with the elements of the presently-claimed invention, or a riser reactor with a ratio of second and first reaction zone

diameters of 1.5:1 to 5:1. Thus, the cited references do not teach all of the elements of the claimed invention, either singly or in combination, and do not render the claims obvious.

In view of the foregoing, Applicants respectfully request reconsideration and withdrawal of the rejection under 35 U.S.C. §103(a).

Claims 8, 16, 24, 32, and 40 are rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Kmecak et al. in view of Williams et al. as applied to claims 1, 9, 17, 25, and 33 above, and further in view of Watts (U.S. Patent No. 2,377, 647). Applicants respectfully traverse this rejection.

The Examiner states that Kmecak et al. are silent regarding a riser reactor configured with an outlet zone and a second junction section located between the second reaction zone and the outlet zone, wherein the second junction section has a circular truncated cone shape. The Examiner further states that Watts teaches a riser reactor comprising an outlet zone and a conjunct section located between the outlet zone and a reaction zone, wherein the outlet zone has a circular truncated shape. The Examiner states that although the collective teachings of Kmecak, Williams and Watts are silent as to the recited vertex angle, it would have been obvious for a person of ordinary skill to select an appropriate vertex angle on the basis of suitability for the intended use.

As discussed above, the combination of Kmecak et al. and Williams et al. does not provide all of the elements of the claimed invention. Therefore, these references are deficient as the basis for an obviousness rejection.

Further, Applicants note that the reactor disclosed by Watts contains only one reaction zone (*i.e.*, reactor 11) and is thus structurally different from the riser reactor as claimed in the present application. As the Examiner admits, Watts does not teach the recited vertex angle. Thus, the combination of Kmecak, Williams, and Watts does not teach all of the elements of the rejected claims as required for an obviousness rejection.

In view of the foregoing, Applicants respectfully request reconsideration and withdrawal of the rejection under 35 U.S.C. §103(a).

Claims 52, 53, and 58 are rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Kmecak et al. in view of Williams as applied to claim 1 above, and further in view of Carr et al. (U.S. Patent No. 3,639,228).

The Examiner states that Kmecak et al. are silent regarding quench medium comprising regenerated catalyst, but that Carr teaches introduction of catalyst at various locations downstream from the inlet of a reactor, and thus it would have been obvious for one of ordinary skill in the art to provide a quenching medium comprising catalyst to the riser reactor of Kmecak on the basis of suitability of intended use.

As discussed above, the combination of Kmecak et al. and Williams et al. does not provide all of the elements of the claimed invention. Therefore, the combination of these references is not anticipatory and cannot serve as the basis for an obviousness rejection. Carr et al. do not cure the defects of Kmecak et al. and Williams et al. Carr et al. teach a method whereby regenerated catalyst is fed into a reactor at different locations. The reactor taught by Carr et al. is structurally different than the presently claimed reactor. Since Carr et al. do not teach the combination of claimed structural features and ratios of diameters of the reaction zones, the combination of Kmecak et al., Williams et al, and Carr et al. does not teach all of the elements of the claimed invention, and this combination of references does not render the claimed invention obvious.

In view of the foregoing, Applicants respectfully request reconsideration and withdrawal of the rejection under 35 U.S.C. §103(a).

CONCLUSION

In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to withdraw the outstanding rejection of the claims and to pass this application to issue. If it is determined that a telephone conference would expedite the prosecution of this application, the Examiner is invited to telephone the undersigned at the number given below.

In the event the U.S. Patent and Trademark office determines that an extension and/or other relief is required, Applicants petition for any required relief including extensions of time and authorize the Commissioner to charge the cost of such petitions and/or other fees due in connection with the filing of this document to Deposit Account No. 03-1952 referencing docket no. 456962000200. However, the Commissioner is not authorized to charge the cost of the issue fee to the Deposit Account.

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